TITLE

MODULAR MUFFLER WITH REMOVABLE CARTRIDGE ASSEMBLY

INTRODUCTION

This invention relates to a muffler assembly and, more particularly, to a muffler assembly of modular concept which is intended to be used with replaceable inserts and other replaceable modules which may be used without discarding the shell of the muffler assembly.

BACKGROUND OF THE INVENTION

Mufflers for cars, boats, motorcycles and other

vehicles are, of course, known. Such mufflers are installed between the manifold of the engine and the engine exhaust discharge point. Mufflers are used to reduce or change the sound of the combustion emanating from the engine of the vehicle and/or boat and also are used to reduce harmful emissions emanating from the engine as a result of the internal combustion.

Known mufflers are constructed from steel or other corrosion resistant material and are welded or crimped together as a unit which unit is then installed inline with the exhaust system of in the boat or vehicle. Such mufflers eventually rust through, are otherwise damaged over time, lose their effectiveness or lack features desired by the vessel or vehicle owner or operator. They are replaced with a new muffler. The owner of the vehicle may wish to enhance the performance of the vehicle and/or change the sound of the exhaust or deal with emission problems by replacing the original muffler with a new muffler.

The muffler replacement procedure usually takes place at a muffler repair or replacement garage which often is inconvenient to travel to and which replacement operation

is time consuming and costly. If the newly installed muffler is not wanted following observations of its performance during actual engine operation, it must be removed and a new muffler installed.

SUMMARY OF THE INVENTION

According to one aspect of the invention, there is provided a muffler assembly used for a boat or vehicle, said muffler assembly being installed between the engine and the engine exhaust discharge point of said boat or vehicle, said muffler assembly having a generally permanent outer housing and a removable and replaceable internal core assembly which is inserted into and removed from said permanent outer housing, said muffler assembly and said internal core assembly having guide and positioning elements to correctly position said internal core assembly within said outer housing.

According to a further aspect of the invention, there is provide a replaceable internal core assembly for a muffler assembly, said internal core assembly being removable from said muffler assembly and comprising at least

one sound reducing element and/or at least one emission reduction element, a sealing plate adapted to engage with said housing and to form a seal between said housing and said internal core assembly and means to guide said internal core assembly into said housing and to maintain said internal core assembly in a removable relationship with said housing.

According to yet a further aspect of the invention, there is provided a replaceable internal core assembly for a muffler assembly, said internal core assembly being removable from said muffler assembly and comprising at least one emission reduction element, a sealing plate adapted to engage with said housing and to form a seal between said housing and said internal core assembly and means to maintain said internal core assembly in a removable relationship with said housing.

According to still yet a further aspect of the invention, there is provided a replaceable internal core assembly for a muffler assembly, said internal core assembly being removable from said muffler assembly and comprising at least one sound reducing and at least one emission reduction

element, a sealing plate adapted to engage with said housing and to form a seal between said housing and said internal core assembly and means to maintain said internal core assembly in a removable relationship with said housing.

According to yet a further aspect of the invention, there is provided a method of installing a replaceable internal core assembly within a muffler assembly having a housing comprising the steps of inserting said replaceable internal core assembly through an opening in said housing, correctly positioning said internal core assembly within said housing and sealing said internal core assembly with and retaining said internal core assembly within said housing in a removable relationship with said housing.

According to still yet a further aspect of the invention, there is provided a cartridge for insertion into a muffler casing, said cartridge containing at least one exhaust treatment element and being sealed prior to installation in said muffler casing, said cartridge containing an entrance for the ingress of exhaust from an engine and an exit for the egress of said exhaust following

treatment of said exhaust within said cartridge.

According to still yet a further aspect of the invention, there is provided a method of treating exhaust emanating from an engine comprising inserting a cartridge into a muffler casing, allowing said exhaust from said engine to enter said cartridge, treating said exhaust within said cartridge to remove environmentally objectionable materials from said engine exhaust and allowing said treated exhaust to pass from said cartridge.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Specific embodiments of the invention will now be described, by way of example only, with the use of drawings in which:

Figure 1 is diagrammatic cross-sectional view of a muffler assembly according to the invention which illustrates the installation of an internal core assembly in a first embodiment of the invention;

Figure 2 is a diagrammatic cross-sectional view of

a muffler according to the invention with an internal core assembly which is used for a purpose different from the purpose of the core assembly of Figure 1;

Figure 3 is a diagrammatic cross-sectional view of an internal core assembly according to the invention without the muffler housing of Figure 1 and further illustrating a decorative tail pipe addition;

Figure 4 is a diagrammatic cross-sectional view of a muffler housing with an installed internal core assembly but illustrating an assembly technique different from that of Figure 1;

Figure 5 is a diagrammatic cross-sectional view of a muffler housing with a partially installed muffler cartridge according to a further aspect of the invention;

Figure 6 is a diagrammatic cross-sectional view of a self-contained cartridge which is intended to be installed within the muffler casing; and

Figure 7 is a diagrammatic cross-sectional view of

the self-contained cartridge of Figure 6 partially assembled within a muffler casing and further including end caps at opposed ends of the muffler casing.

DESCRIPTION OF SPECIFIC EMBODIMENT

Referring now to the drawings, a muffler assembly according to the invention is generally illustrated at 100 in Figure 1. It comprises an outer housing or shell 101 having an exhaust entry pipe 102 embedded in the outer housing 101 and a modular core assembly retainer 103 in the form of a threaded and pointed male post likewise embedded in the housing 101, conveniently as by welding.

A modular core assembly is shown generally at 104 which assembly 104 is inserted into and removed from the housing 101 when replacement is desired. The modular core assembly 104 comprises two perforated pipes 110, 111 of similar design which are intended to reduce the sound of the exhaust entering the muffler assembly 100 through exhaust entry pipe 102. Perforated pipe 110 has a male pipe 112 extending from the end adjacent the exhaust entry pipe 102 which pipe 112 fits inside the exhaust entry pipe 102 when

the muffler assembly 100 is assembled. The opposite end of perforated pipe 110 is connected to a support or backing plate 113 which will be described in greater detail.

Perforated pipe 111 includes an alignment and retention member 114 which is complementary to modular core assembly retainer 103. Member 114 is threaded and assembly retainer 103 is threadedly inserted into the member 114 also as will be explained. Perforated pipe 111 extends through backing plate 113 and terminates in a tail pipe 121. Perforated pipe 111 and associated tail pipe 121 are rotatable in the backing plate 113 within a circumferential seal 120 which surrounds the perforated pipe 111 and which seal 120 seals the perforated pipe 111 and tail pipe 121 within the housing 101. Seal 120 allows rotation of the pipe 111 within the seal 120 and therefore within the backing plate 113.

Tail pipe 121 extends rearwardly of the backing plate 113, it being understood that the engine (not shown) of the vehicle or boat is located leftwardly of the muffler assembly 100 illustrated in Figure 1.

OPERATION

In operation and with reference to Figure 2, it will be appreciated that the modular core assembly 104 is intended to be a separate assembly from the muffler housing 101 with its integrally assembled exhaust entry pipe 102 and modular core assembly retainer 103. Housing 101 has a circumferential crimp 122 formed in the housing 101 which allows an abutment by the backing plate 113 against the internal surface of the circumferential crimp 122 to thereby correctly position the modular core assembly 104 within the housing 101 during the assembly operation.

The modular core assembly 104 is ordinarily assembled remotely from the housing 101 and will comprise the backing plate 113, the perforated pipes 110, 111, the seal 120 and the tailpipe 121 and the male pipe 112. The assembly 104 will be inserted into the opening of the housing 101 with the alignment and retention member 114 being generally aligned with the assembly retainer 103 connected to the housing 101 and with the female pipe 112 being generally aligned with the exhaust entry pipe 102. As the modular core assembly 104 is moved leftwardly and into

the housing 101, the male pipe 112 will move inwardly on exhaust entry pipe 102 and retention member 114 will likewise move into engagement with assembly retainer 103.

The user will then rotate extending tail pipe 121 within the backing plate 113 and seal 120 which tail pipe 121 rotates perforated member 111. This allows engagement between the threaded retention member 114 and the assembly retainer 103 and as rotation of the tailpipe 121 continues, the assembly 104 will move leftwardly under the tightening sequence until the backing plate 113 comes into firm contact with circumferential crimp 113. The assembly is then complete.

If it is intended to remove the assembly 104 for reasons for replacement, repair or otherwise, the tailpipe 121 may again be rotated in an opposite direction either manually or with an appropriate tool and the sequence is reversed. That is, the threaded connection between the member 114 and the retainer 103 will force the assembly 104 rightwardly until the threaded engagement is disconnected whereupon the assembly 104 is manually removed from the housing 101.

A further embodiment of the invention is illustrated in Figure 2. In this embodiment, perforated member 111 used to reduce the sound of engine exhaust in the Figure 1 embodiment, is replaced with a filter 211 while the perforated member 110 of Figure 1 is replaced with a further perforated member 210. The filter 211 is used to reduce environmental contamination emanating from the engine and entering the muffler assembly 200 through exhaust entry pipe 202 and may, of course, be designed to remove or reduce specific contaminants required by legal mandates or as desired by the owner. Perforated member 210 may be of a different design from perforated member 110 but it is intended to likewise reduce sound similarly to that of the Figure 1 embodiment. It will be appreciated that if a filter 211 becomes ineffective over time and replacement is desired, the removal and installation procedure described will be used without the necessity of the removal or replacement of the housing 201 and, in fact, the replacement installation may take place with the housing 201 remaining in situ within the boat or vehicle in which it is installed.

A further embodiment of the invention is illustrated in Figure 3. In this embodiment, a decorative

tail pipe 330 is attached to the tailpipe 321 and the perforated members 310, 311 are of a design that is less restrictive of exhaust flow than the embodiment of Figure 1. Back pressure is thereby reduced and engine performance is increased. This assembly 304 is attractive for users who wish to increase the performance and looks of their vehicle with minimal difficulty and cost in doing so.

A further embodiment of the invention is illustrated in Figure 4. In this embodiment, the housing 401 includes, in addition to the circumferential crimp 422, a circumferential lip 431 which bends inwardly and which may be used to secure a circumferential spring clip 432 of appropriate design such that when the backing plate 413 is manually inserted until it abuts the circumferential crimp 422, spring clip 432 may be inserted and which bears between the backing plate 413 and circumferential lip 431 and increases the sealing force of the backing plate 413 against the circumferential crimp 422.

Many modifications will readily occur to those skilled in the art to which the invention relates. For example, the muffler assembly 100 according to the invention

may be located upstream or downstream from a further and primary muffler if the application warrants such a configuration. Likewise, the muffler assembly 100 may comprise only emission reduction elements such as a filter or only sound reducing elements rather than being a combination of those elements as has been described. Also as described herein, the term "filter elements" is intended to cover apparatuses that may not strictly filter the exhaust but are intended to cover apparatuses that are intended to remove contaminants other than through filtering such as through chemical, mechanical or electrical reactions.

A further embodiment of the invention is illustrated in Figure 5 and 6. In this embodiment, a cartridge generally illustrated at 500 is illustrated in partially assembled condition with respect to muffler casing 501. The cartridge 500 is intended to be sealed; that is, the cartridge 500 has a gas tight enclosure 502 which houses the filter elements 502 and the perforated member 504 previously illustrated in Figure 2.

The advantage of the cartridge 500 having a gas

tight enclosure 502 is such that protection is obtained for the contents of the cartridge 500 during shipping. It further allows the installation of fragile and sophisticated environmental control components which may be removed when fully utilised and contained during the subsequent handling and removal operation. In this event, the outer muffler casing 501 need not be gas tight and the sealing operation is considerably simpler during installation. A snap ring 510 may be used to maintain the cartridge 500 in its installed position within the muffler casing 501, the snap ring 510 resting within a recess 511 associated with inturned lip 512 of casing 501.

The installation of the cartridge 500 follows the installation similar to that of the embodiment of Figure 2. A protruding pin 513 enters complementary recess 514 of the cartridge 500 during installation and the pipe 520 enters the exhaust inlet 521. Snap ring 510 is installed in the recess 511. The installation is then complete.

A further embodiment of the invention is illustrated in Figures 6 and 7. Figure 6 illustrates the cartridge form of the muffler insert with the cartridge

being generally illustrated at 600. It is similarly gas sealed as in the Figure 5 embodiment but the contents of the cartridge 600 are highly sophisticated pollution devices used to reduce and remove harmful exhaust emissions. For example, a plasma reactor electrode used with a dielectric is shown at 601 and high voltage may be applied to the cartridge 600 through a high voltage conductor 602 which conveniently has a slip ring 603 contacting a brush 604 on an end cap generally illustrated at 610 which brush 604 is connected to an electrical conductor 611 on the end cap 610 to which high voltage power may be applied. Catalysts or adsorbent material or other chemical materials 612 may likewise be provided to assist in the removal of treated emissions from the exhaust. A bulkhead 613 may be conveniently provided to separate the cartridge 600 into separate compartments where individual exhaust treatment processes may be performed to assist in exhaust cleansing without contaminating the process carried out in an adjacent compartment. A second end cap generally illustrated at 614 is also conveniently provided to close the muffler casing 620 and to provide a path for the exhaust from the engine directly into the cartridge 600 as is shown.

When assembling the second end cap 614 to the casing 620, an end cap retention device 621 is provided to maintain the end cap 614 in secure position within casing 620. A tensioning screw cap 622 is conveniently provided to produce a force on a pipe shoulder 623 thereby to maintain the pipe 624 firmly within the end pipe 630 of the cartridge 600. A tension nut 631 conveniently acts against tensioning springs 632 which tensioning springs 632 allow a tolerance for dimensional changes of the assembly and which also provide a safety function by absorbing to some extent the force created by an unplanned explosion within the cartridge 600.

First end cap 610 has components similar to those of second end cap 614. A tensioning screw 634 is provided as well as a tension nut 633 with associated tensioning springs 640. A cap retention device 641 is provided to attach the end cap 610 to the casing 620 during installation and operation with the pipe 642 of the first end cap 610 being firmly inserted into a complementary entryway 643 of the cartridge 600. Thermal insulation 644 is also conveniently provided to ensure a thermal seal is in place between the cartridge 600 and the end cap 610 and to

insulate the end cap 610 from the high temperatures that may be present in the cartridge 600.

Following installation of the cartridge 600 into casing 620, exhaust from the engine (not illustrated) leave pipe 624 and enters the cartridge 600. The exhaust gas flow is illustrated by the arrows shown in Figures 6 and 7 with the exhaust being exposed to the plasma reactor electrodes and dielectric 613 and, thereafter, to any catalyst or adsorbent material 612. The treated exhaust then departs the cartridge 600 and enters pipe 642 of end cap 610 where it passes to the tail pipe or exhaust system of the vehicle or vessel into which it is installed.

Many further modifications will readily occur to those skilled in the art to which the invention relates and the specific embodiments described should be taken as illustrative of the invention only and not as limiting its scope as defined in accordance with the accompanying claims.